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NEW FOSSILS FROM THE UPPER CARBONIFEROUS OF KANSAS.

BY J. W. BEEDE.

With Plate V.

THE following will be of interest and value in completing the faunal succession of the uppermost part of the Carboniferous, as well as for the biologic interest of one of them.

Ceriocrinus harshbargeri, n. sp. Plate V, figs. 1–1c.

The distinctive features of this species are: Surface ornamented with both pustules and granules, large interradial supporting plate above calyx, ten short, massive arms.

Description: Calyx basin-shaped, shallow, quite concave below. Infrabasals partly covered, but located entirely within the body cavity. Stem small and apparently round. The five basals are large, recurved below the middle, concave in the center of the more depressed part, four apparently hexagonal and one heptagonal, and larger than the others supporting the interradial; all higher than wide, sutures not much depressed. There are five large, massive radials a trifle more than twice as wide as high, well beveled, faceted, and apparently sagging a little on the upper articular surface. Interradial large, fully half within the calyx, higher than broad, and the upper portion very strongly curved inward. This plate supports another entirely without the calyx, which is comparatively large and appears to be pentagonal when seen from without, the two upper sides being much longer than the rest, making the plate appear triangular at first sight, fitting closely between the arms on either side. The five brachial plates are large, contiguous save on the posterior side, and produced into an obtuse spinous process. Much of the upper surface of these processes is faceted, supporting the costals, and in this manner giving the animal its greater lateral diameter above the calyx, and affording more room for the massive arms which, when closed, form a box around

the inner part. The costals are ten in number, two to each brachial, large, nearly three times as broad as high, and convex. The distichals are sometimes present and sometimes wanting, very broad and thin when present. Arms ten, broad, outer surface of each nearly flat massive, composed of two series of interlocking plates, each one of which bears a pinnule. Pinnulæ long and narrow. The articular surface of the arm plates is minutely crenulated. These plates decrease in length though but little in height as they approach the tips of the arms. The surface of almost the entire animal was ornamented with granules, and the lower part with both granules and pustules.

Measurements:	height.	breadth.	length.
Calyx	11 mm.	30 mm.	
Basals (vertical)	5½ "	12 "	
Radials	9 "	18+"	
Brachials	7 "	17 "	8 mm. beyond calyx.
Costals	4 "	9 to 11 mm.	
Distichals	2 "	9 "	
Arm plates	2 "	3 to 5 "	
Interradial	7 "	6 "	

Aside from the markings mentioned, the calyx is also ornamented with depressions which look at first like borings of some kind, but which have the same granular character as the rest of the surface.

Position and locality: Carboniferous, Upper Coal Measures, Topeka, Kan., from the Osage City shales, over the Osage coal.

The type was collected by Prof. W. A. Harshbarger, in honor of whom it is named. Type now in the collection of Washburn College.

In general appearance this species is strikingly like *C. craigii* Worthen, but differs in the following respects: The body is not smooth but highly ornamented, and the anal piece is much larger. In all specimens of *C. craigii* that I have seen the body is smooth and glossy, and shows (even when apparently unworn) no indications of former surface-markings, while this species possesses both pustules and granules, the latter covering about the entire specimen. In mature individuals the interradial is much larger. Two smaller specimens, probably younger ones of this species, are figured in the accompanying plate, showing the relative growth of the calyx and interradial. In both the ornamentation is the same as described in this species. *C. monticulatus* Beede is from the same locality and horizon, but has long, slender arms, brachials not spinous, and the calyx is deeper. The most fundamental difference, however, is the number of arms possessed by the latter species, the number being sixteen or eighteen, while the one here described has but ten.

C. nodulifera Butts differs from this species in having a node at the upper part of each basal and also on the radials. It also has

more acute and apparently longer spines. Mr. Butts makes no mention of finer surface-markings. The Topeka specimen is from a much higher horizon.

Aviculopecten subequivalvus, n. sp. Plate V, figs. 3, 3*a*.

Shell thick, moderately large, subequivalvular, rather convex, quite oblique, ears well developed. The hinge is nearly straight, the beak does not project, the angle of divergence of its sides is about eighty to ninety degrees. The left valve, exclusive of the ears, is ovate; anterior ear well developed, obtusely angular, marked only by strong lines of growth; the rise from the ear to the body of the shell is abrupt; the marginal sinus separating the ear from the rest of the shell broad, shallow, and ill-defined. The posterior ear is unknown. The anterior margin below the ear forms an ovate curve, which is probably continued on the ventral and postero-ventral margins. The surface of this valve is apparently marked only by stronger and fainter concentric lines except on the front and back sides, where there are radiating rows of vaulted lamellæ. It is entirely probable that these marks once extended over the entire surface, but have been worn off from the more convex portions. Judging from another specimen, the right valve is somewhat flatter than the left and quite as oblique. Posterior ear very small and obtuse; anterior ear quite large, marked by obscure, large, radiating ribs and probably vaulted lamellæ, as well as strong concentric markings; separated from the shell by a deep sulcus. Margin from the beak around the posterior to near the middle of the shell is a regular ovate curve, antero-ventral margin somewhat produced but rounded, extending obliquely toward the beak until the deep byssal sinus is reached. Ornamentation as in the other valve. In this specimen it seems that the radiating rows of scales covered the entire surface before being worn away. Length, 36 mm.; height, 32 mm.; hinge, 17 mm.; thickness, about 5 mm.

Position and locality: Thin limestone, south of Dover, Kan., in Upper Coal Measures. Type in author's collection.

This shell may prove to be a *Pseudomonotis*, as the critical characters are not well known. It is not liable to be confused with any other shell from the Coal Measures.

Pinna lata, n. sp. Plate V, fig. 4.

Shell small for this genus, not very convex, probably plain except the usual growth marks, acutely pointed at the beaks, which are terminal. The angle of divergence of the shell is thirty degrees. This species is based on three casts. The type is not distorted, but the posterior end is broken away. There are two other specimens from

the same locality, but compressed dorso-ventrically, which show the same characters as the type. The size is about that of *Aviculopinna americana* Meek, but the form and markings as shown on the cast are very different, and the beaks are terminal. Length of type along hinge, 27 mm.; height (20 mm. back of beak), 11 mm.

Position and locality: Carboniferous, Upper Coal Measures, Howard limestone, Topeka, Kan.

The small size, great angle of divergence at the beak and sharp-pointed beaks easily distinguish this species from other members of the genus from the Coal Measures.

Pleurophorus whitei, n. sp. Plate V, figs. 5, 5*b*.

Pleurophorus —? White, Bull. U. S. Geol. Surv. 77, p. 27, pl. IV, figs. 5–10.

Shell of medium to large size, transversely ovate, with the depth of the shell greater at the anterior than at the posterior end. Beaks moderately prominent, subterminal; umbonal ridge prominent, extending obliquely to postero-ventral margin. Hinge straight or arcuate, usually about three-fourths the length of the specimen. The right posterior lamina is well shown on good casts. The anterior adductor impression is usually prominent, being set apart by the depression produced by the ridge behind it. The impression of the two cardinal teeth is also visible. The anterior margin drops obliquely downward from the beak nearly to the middle of the shell, when it rounds, rapidly at first, into the ventral margin, which may be straight, somewhat sinuous or even convex on approaching the postero-ventral region; at the end of the umbonal ridge it rounds rapidly into the posterior, oblique truncation, reaching the hinge at an oblique angle. The lines formed by the hinge and ventral margins converge toward the posterior, thus leaving the greatest depth of the shell in front. Above the umbonal ridge the shell is obliquely flattened to the hinge. The surface, as shown in excellent molds, is ornamented only by fine lines of growth, which are sometimes a little stronger beneath the beak than elsewhere, and weaken on and above the umbonal slope.

Position and locality: This species is found in the Upper Coal Measures, upper Wabaunsee stage, east of Barrett, Kan. This is the only locality known to the writer where this shell, abundant in the Permian, is found below the Wreford limestone. Types from Permian west of Stockdale, Kan., "about 100 feet above Cottonwood limestone." Collected by Prof. E. A. Popenoe.

This species is extremely variable, as shown in Professor White's figures, above cited. The short shell with the posterior shallower than the anterior end is in sharp contrast to most of the species of the genus. In surface ornamentation it resembles *P. tropidophorus*

more closely than any other species. It is distinguished from *P. subcuneatus* Meek by its short, thick form and larger size. This species is the more abundant of the two in the Permian rocks of the Big Blue series, while *P. subcuneata* only has been identified from the Cimarron series.

Allorisma kansasensis, n. sp. Plate V, figs. 6, 6*d*.

Shell small, rather gibbous, transversely subovate. Beaks prominent, incurved, approximate, located about one-third the length of the shell from the anterior end. Anterior outline descending obliquely from the beaks nearly to the ventral margin, where it turns rather abruptly backward along the nearly straight basal edge to the posterior extremity, where it rounds off regularly upward and then forward to meet the hinge. The hinge is apparently straight and more than half as long as the shell. The umbonal ridge is prominent, rounded, ill-defined, fading away at the extremity of the shell. Above this ridge is a depression which, with the smooth, elevated hinge, would cause a strong keel on the shell back of the beaks. The concentric ribs are prominent, fading out at the upper part of the umbonal ridge and near the anterior border. These ribs are quite as prominent on the casts as on the shell itself. On the central and postero-central regions are the characteristic distant, radiating rows of fine, closely set granules. The shell is less convex below and back of the beak than on either side of this region, though it is not concave. The length varies from 1.7 to 1.4 the height.

Position and locality: Upper Coal Measures, Howard limestone, Topeka, Kan.

This species is very closely related to *A. curta* Swallow, but differs from it in having a straighter hinge and a more remote beak. It is from a lower horizon. In the latter respect it differs from McChesney's species also.

PALEONTOLOGICAL LABORATORY, INDIANA UNIVERSITY,
MAY 22, 1902.

Explanation of Plate V.

All figures about natural size. Drawings by C. McK. Beede.

Ceriocrinus harshbargeri.

FIG. 1. Right posterior view of type.
FIG. 1*a*. Diagram of anal plates of same.
FIG. 1*b*. Surface detail enlarged.
FIG. 1*c*. Diagram of basal view.
FIG. 2. Calyx of another specimen, probably of this species.
FIG. 2*a*. Diagram of a portion of posterior view of another slightly smaller specimen, showing variation in size of anal plate.

Aviculopecten subequivalvus.

FIG. 3. View of type. One side incomplete.
FIG. 3*a*. Opposite valve of another specimen.

Pinna lata.

FIG. 4. View of type, a left valve.

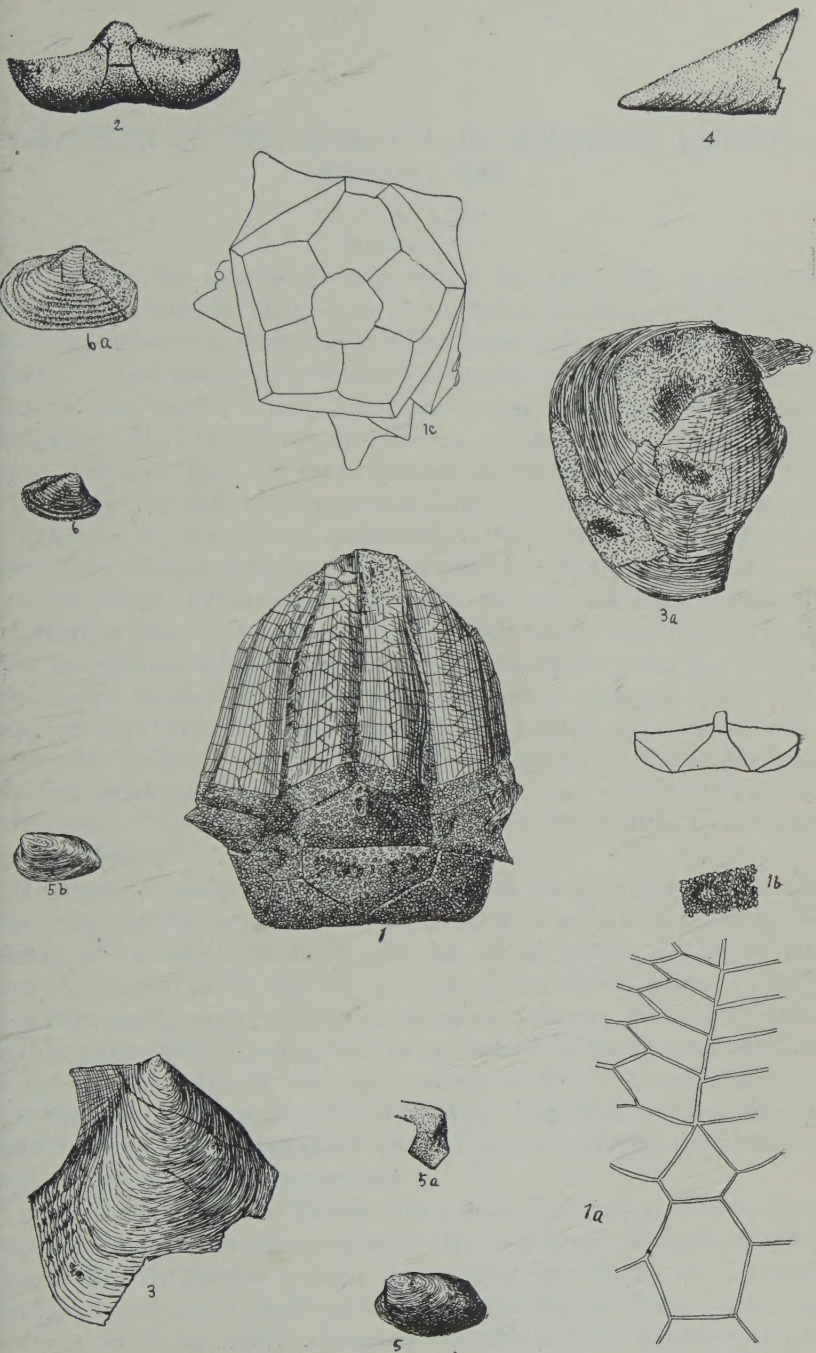
Pleurophorus whitei.

FIG. 5. Type specimen; cast of a left valve on the same slab as the two following and the cephalothorax of a large limuloid.
FIG. 5*a*. Cast of a broken specimen, showing the anterior muscular impressions.
FIG. 5*b*. Specimen of different outline.

Allorisma kansasensis.

FIG. 6. Imperfect cast, showing strong concentric undulations impressed upon it.
FIG. 6*a*. Lateral view of type. Shell exfoliated in front.

PLATE V.



VARIATION OF THE SPIRALIA IN SEMINULA ARGENTIA (Shepard) Hall.

BY J. W. BEEDE.

With Plate VI.

Owing to the systematic importance and the rarity of good material of the brachial framework of the brachiopods, any light on the extent of individual variation of these parts is of considerable importance. In the spring of 1899 the University of Kansas received from Prof. C. N. Gould a set of ten specimens of *Seminula argentia* (Shepard) Hall that show the position of the spires. These specimens were all from the same horizon in the Lower Permian. The University also had another specimen showing these characters, as did a specimen in the writer's collection. Recently the study of these specimens was taken up and some remarkable results developed.

Both valves of this species are quite convex and not infrequently as broad as long. The older specimens are quite ventricose. However, the shell is subject to a considerable variation in form. Four of the twelve specimens studied were somewhat compressed, but it so happens that three of these approach the normal type very closely, while the fourth does not vary from it greatly. Those showing greatest variation have not been subject to any visible external deformation. The specimens under discussion are of about the average size and form.

The normal position of the spire is with its apex pointing to the side, near the line where the valves meet, at, or a little in front of, the middle of the shell, which is also the widest point. In the central part of the shell cavity the edges of the spires nearly meet. In front they flare apart, leaving a large, subcircular opening. For convenience, in this paper, this opening will be spoken of as the frontal aperture of the spiralia. It will also be necessary to orient the specimens so that definite positions may be referred to. For this purpose we will consider the specimens as front toward (back away from) the observer, with the brachial valve uppermost.

A specimen from the Topeka limestone, Upper Coal Measures, at Topeka, Kan., shows the spires with the apex of one of them pointing almost directly forward toward the anterior end of the shell, turned through a horizontal angle of about ninety degrees from its normal position, while, as nearly as may be determined from the specimen as cut, the apex of the other one is directed toward the median line of

the pedicle valve just in front of the hinge. This specimen was selected to be ground, because it was a good specimen, of normal form. Another specimen (No. 3), from the Permian of Cowley county, Kansas, has the apices of the spires turned at an angle of about forty-five degrees or more in a vertical direction, causing the point of the spire to be located near the middle of the right side of the brachial valve, while the other points to the opposite of the pedicle valve. The spire is quite flattened, approaching disk shape, with the apex quite obtuse and the frontal aperture very narrow and almost slit-like (this may be partially due to a very slight compression, but the compression, if present, is so slight as to modify it very little), owing to the position of the spires in the shell, which prevents their flaring much at the front. The shell is not an old one, and, for this reason, is somewhat less ventricose than many adults. The young specimens are much flatter than the old ones in this species.

The spiralia of No. 10 are turned in a similar manner, but through a much smaller angle. The frontal aperture is typical, as is also the general form of the shell. The spiralia are conical, and the tips probably acute. In No. 6 the position of the spiralia, their form and that of the aperture are normal. Nos. 6 and 9 show spines on the spires The spines are closely set, thick, blunt, and nearly twice as long as broad. In fact, some appear to be nearly as large at the tips as at the base. In No. 9 the spires are normal, except that, instead of being flaring conical, they are more in the shape of a folded shield shape with acute apex. In other words, the frontal aperture is produced by the dorso-ventral compression of the entire cone rather than the flaring of the frontal portion. The apex of the left spire is bent somewhat downward. The position of the spiralia in No. 7 is about normal, the tips obtuse, the spires almost perfectly depressed conical, frontal aperture only slightly wider than the space farther back on the side next the brachial valve. No. 5 has apparently been compressed laterally, through this compression did not affect the positions of the spiralia, for they are normal. They appear to have been of the typical form in every respect. In No. 8 the spires seem to have been turned through a slight vertical angle, though the incompleteness of the specimen prevents a close study of position. The form was apparently normal, except that the lower edges may have been somewhat pressed inward. Nos. 1 and 4 are about normal throughout. No. 2 is normal as far as can be seen, except that the apices are turned through a small vertical angle. The anterior portion of the pedicle valve is crushed in. No. 12 is normal throughout.

It is unfortunate that none of the specimens show the crural at-

tachment of the spiralia. Such structures must certainly vary in order to support the spires in their various positions.

The above facts would seem to indicate the following conclusions: First, in those spire-bearing brachiopods in which the form of the shell does not govern the position of the spires, the Athyridæ in particular, the spires may be subject to a considerable variation in both position and form. Second, that the crural supports are probably so modified as to accommodate the spires in their various positions.

In the light of the foregoing, it will be seen that in the future it will be necessary to study the structure of several specimens before using small variations of internal structure in these shells as bases for group divisions.

One might expect greater individual variation among the Flint Hills specimens, owing to the physical changes that were taking place during the close of the Carboniferous and the early Permian; changes which soon caused this species, together with many others, to become extinct. However, this cannot be said of the most striking case (No. 11) from the Topeka limestone. It would seem that such variations as are found in Nos. 3 and 11 would be decidedly detrimental to the well-being of the animal, though the latter of the two seems to have been a vigorous individual.

INDIANA UNIVERSITY, BLOOMINGTON,
APRIL 8, 1902.

Explanation of Plate VI.

Drawings by Sydney Prentice, except No. 12, which is by C. McK. Beede.
All specimens natural size.

Seminula argentia. Variation of spires.

FIG. 1. Specimen brachial side up.

FIG. 2. This specimen shows spires viewed with pedicle side partly removed.

FIG. 3. Pedicle view, showing part of spire.

FIG. 3*a*. Above individual, brachial side up.

FIG. 4. Brachial side of fig. 4*a*.

FIG. 4*a*. Pedicle view of specimen, showing position of spires.

FIGS. 5 and 5*a* are the brachial and pedicle views of a somewhat laterally compressed specimen.

FIG. 6. Pedicle view of specimen.

FIG. 6*a*. Brachial view of fig. 6.

FIGS. 7 and 7*a* are the brachial and pedicle views of a specimen.

FIG. 8. This figure probably shows the brachial side of specimen, while fig. 8*a* is the opposite side.

FIG. 9. Brachial view.

FIG. 10. The pedicle view of a specimen, and fig. 10*a* the brachial side of the same.

FIG. 11. Brachial valve nearly ground away, to show spire. The sickle-shaped structure is probably the base of the opposite spire. Beede's collection.

FIG. 12. Specimen with brachial valve largely broken away.

All specimens but No. 11 in collection of University of Kansas.

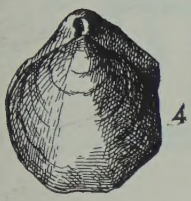
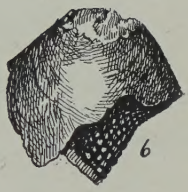
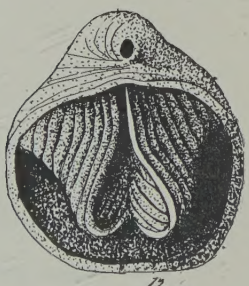
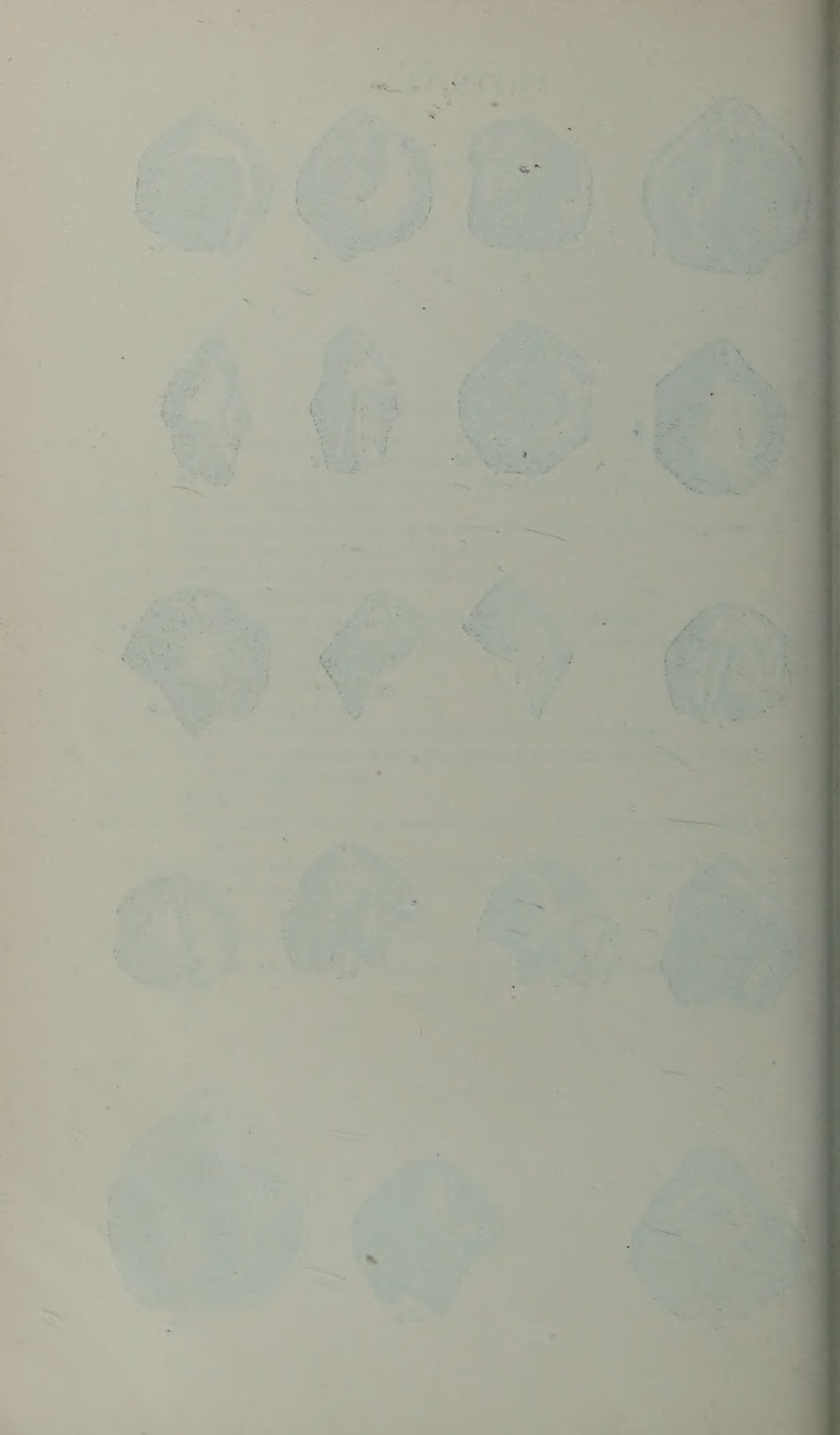



PLATE VI.